ON THE GUESSING OF NUMBERS.

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The psychology of Belief has received some attention from psychological writers, but the psychology of Guessing—the formation, in the absence of adequate data, of estimates and opinions about the ordinary affairs of life—has not often been considered. A thorough-going study of it might, however, be expected to throw light upon some of the less obvious, and perhaps unconscious influences, that determine opinion and action. The discussion which follows is a fragment of such a study with reference to a sort of guessing of which instances are particularly easy to obtain in quantity, the guessing of numbers in "Guessing Contests."

This field is not wholly a new one. Professor F. B. Dresslar has contributed to the *Popular Science Monthly* (Vol. LIV, 1898-99, pp. 781-786), a study on "Guessing, as Influenced by Number Preferences," based upon the guesses recorded in a "guessing contest" upon the number of seeds contained in a monster squash. Professor C. S. Minot reports in an early number of the Proceedings of the American Society for Psychical Research (Vol. I, 1885-89, pp. 86-95), an investigation of "Number Habit," which, though making use of material from quite a different source, bears upon the same general question. Still others have written with reference to number habit or number preference as these appear in the census returns and in judicial sentences. To these special reference will be made below.

The material for the present study was derived from a "guessing contest" conducted for advertising purposes by a Worcester dealer in photographic supplies, the prize being a valuable camera. The guesses were upon the number of beans in a "five pint" bottle filled to the cork with small white beans and conspicuously displayed in the show window. Customers were given with their purchases cards with places

marked for the inscription of a number and for a name and address. These cards were filled out at the time or later, and deposited in a box conveniently placed for the purpose. The cards deposited furnish the statistical record for the following study.[1] On the cards appear the names of 765 persons, 651 men and boys, 114 women and girls; and 10 cards were deposited without name. The total number of cards coming into my hands was 2,817. The guesses range from 285 to 3,425,602 for the men and boys, and from 250 to 2,675,181,756 for the women and girls. Guesses of 1,000,000 or over are few in number, and some, if not all, were probably set down in sport. Of the total number of guesses 2,573 were made by men and boys, 244 by women and girls. The actual number of beans, as reported in a current newspaper item on the award, was 8,834, and the winner a man.[2] The vast majority of the contestants guessed but once or twice, but a few guessed as frequently as 30 or 40, and two, more than 50 times each.

As it seemed likely that the conditions under which repeated guesses would be made might be different from those of the casual guesser, the cards were separated into two groups, one consisting of the guesses of those whose names appeared not more than five times, the other of those who guessed six times or more. Later the guesses of the women and girls were removed from both groups for separate consideration, making three groups in all. The following study covers the first and last of these groups; the frequent guessers for the present have been left out of account.

The group of infrequent guessers consisted of 535 persons (men and boys), who, with the anonymous guessers, deposited a total of 1,050 cards, an average of not quite two cards apiece. It is fair to suppose that we have in this group a set of guesses practically uninfluenced by considerations outside those involved in the simple guessing at the number of beans, and so large that individual tendencies will disappear in the mass. The group is thus fitted to show general tendencies, if any such exist.

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[1] My thanks are due to Mr. Langdon B. Wheaton, for kindly placing this material at the disposal of the Psychological Department of Clark University.

[2] *Worcester Evening Gazette*, Jan. 1, 1901, p. 1.

Of the original 1,050 cards two were removed because of illegibility, and one group of five from a single guesser were thrown out because the numbers showed signs of planful choice. The following relations have been worked out on the basis of the 1,043 cards remaining.

The range of guesses here was 285 to 1,000,000. The median guess (the middle one when the 1,043 guesses were arranged in order of size), was 7,257, over 1,500 short of the actual number if the newspaper figures were correct. The medians of the upper and lower halves of the series, which give the limits within which falls, as nearly as may be, one-half the total number of guesses, are 4,173 and 9,536. The range from 1,200 to 16,000 includes a little short of nine-tenths of the guesses. The following table shows the distribution in the several thousands up to twenty thousand.

TABLE I.

Distribution of 1,043 guesses according to the thousands in which they fall.[1]

0 — 999	31	7,000 — 7,999	142	14,000 — 14,999	10
1,000 — 1,999	86	8,000 — 8,999	113	15,000 — 15,999	11
2,000 — 2,999	78	9,000 — 9,999	100	16,000 — 16,999	5
3,000 — 3,999	55	10,000 — 10,999	57	17,000 — 17,999	10
4,000 — 4,999	76	11,000 — 11,999	34	18,000 — 18,999	3
5,000 — 5,999	71	12,000 — 12,999	23	19,000 — 19,999	6
6,000 — 6,999	87	13,000 — 13,999	10	20,000 and over	35

In this table there is a massing of the guesses between 7,000 and 10,000, but also a disproportionate number falling between 1,000 and 3,000. The first is no doubt the result of a genuine effort to estimate the number of beans in the bottle—an estimate in units of a thousand is, under the circumstances, not at all unreasonable. The second is probably not due to such an effort, nor yet to a wide-spread preference for the digits 1 and 2,

[1] The grouping used in this table is, strictly speaking, not quite as stated in the heading. The first thousand should include the figure following 999, and the second that following 1,999 and so on, but it is safe to say that in the minds of most guessers the change to a new numerical species occurs when the digit appears or is changed in the thousand's place. Witness the popular confusion as to whether the 20th century began with New Year's day 1900 or 1901.

but rather, it would seem, to the fact that many careless or indolent guessers used the numbers 1,000 and 2,000 (and the other numbers falling in these thousands) to indicate indefinitely "some large number." This would agree also with the fact that a large proportion of round numbers appear among the guesses falling within these limits. (*Cf.* tables in the section on Round Numbers below.)

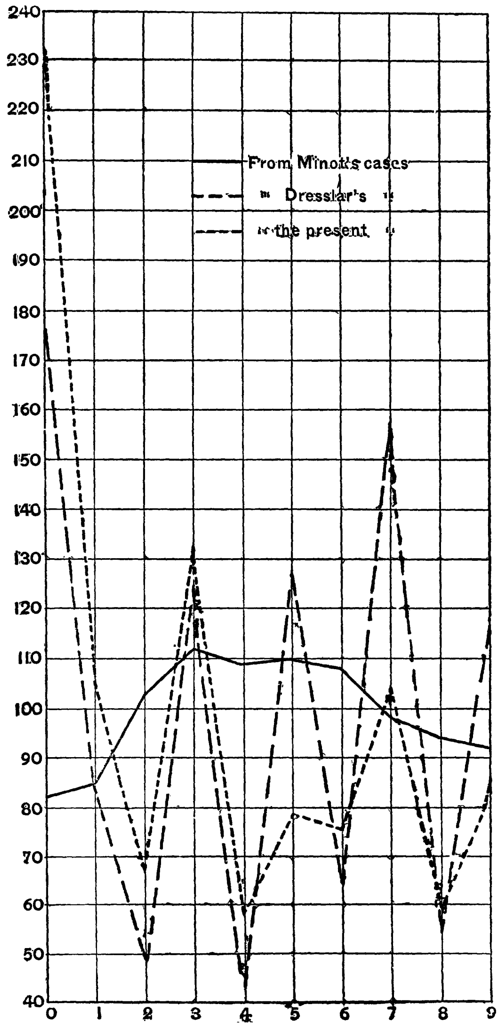
If the digits in the thousands' place are determined, in so far as they are not merely careless, by a bona-fide estimate of the number of beans, the digits in the tens' place and still more those in the units' place must be looked upon as determined by subjective considerations,—that is, as pure guesses. It is in the frequency of the recurrence of different digits in these places, therefore, that we may fairly look for number habits or number preferences. Here, also, it is possible to compare our results with those of Minot and Dresslar. Dresslar's statistics were derived, as I have said, from guesses made at the number of seeds in an uncut squash; Minot's came from the tables of digits set down by "percipients" in certain tests of "thought transference." The conditions of the guessing were thus similar in the three studies but not identical. Minot's guessers were confined to the first nine digits and zero (or ten). Dresslar's, though there was no limit set, fixed for the most part, upon numbers lying below 1,000. In Minot's cases there was absolutely no objective suggestion of the number to be guessed, and in Dresslar's only such as might arise from recollection of the appearance of other squashes when cut. In the present case, however, the beans could be seen distinctly through the glass of the bottle and there was a definite suggestion of multitude. Minot's material was gathered from the guesses of ten persons, Dresslar's and my own from the combined guesses of many individuals. The tables of Minot and Dresslar rest upon much larger masses of data than mine, Dresslar's covering 7,700 guesses and Minot's 8,600. My 1,043 instances are sufficient, however, for such comparisons as I shall institute.

The relative frequency of the digits as they appear in Minot's material and in the units' place in Dresslar's and mine is shown in the following table and chart. The figures in the table are all reduced to a thousand basis for ease of comparison.

TABLE II.

Frequency per thousand guesses of the various digits when guessed singly, or when set in the units' place in larger numbers.

DIGITS.	0	1	2	3	4	5	6	7	8	9
Minot's Cases,	83	85	103	112	109	110	108	98	94	92
Dresslar's Cases,	179	84	49	125	43	128	64	156	54	116
Present Cases,	231	107	67	132	58	79	75	105	59	85



It will be observed at once that the frequency curve given by Minot's cases is strikingly different from the other two. The variations from digit to digit are not extremely great; there is a gradual rise from the beginning to the middle numbers of the series, followed by a gradual decline in the later ones; and there is practically no difference between odd and even numbers. The other two curves agree in direction throughout, and, except for the greater frequency of the fives, sevens and nines in Dresslar's curve, may be regarded as essentially parallel. They agree in showing a high frequency for zero and for the odd numbers, with an equally marked deficiency in the even numbers. The difference between the curve for Minot's cases and the other two comes undoubtedly from the difference in the conditions under which the guessing took place. Minot's guessers were limited to the first ten digits and tended somewhat to avoid the numbers at either end of the scale. Traces of this tendency, though appearing less uniformly, are to be found in the records of most of his ten subjects. (See his table giving the individual records, p. 90 of the paper cited.) Subjects required to choose numbers within such restricted limits probably tend, as they make guess after guess, to pass irregularly up and down the series, and this brings them twice across the middle region for one arrival at either end, and so increases the probability of guesses from that region.[1] For this reason, also, Minot's material is not very well suited to bring out general number preferences, if any such exist, for they are cut across and obscured by the movements up and down the scale. The smaller number of guesses per individual, and the greater range of guessing allowed by the conditions under which the data for the other two studies were gathered, freed the guessers

[1] Prof. Minot does not consider this bunching of the guesses upon the mid numbers of the series. He discovered, however, a very marked tendency in one of his guessers to move with considerable regularity up and down the digit scale. He also tried to determine by statistical means whether or not the other subjects had a similar habit, but with largely negative results. In spite of this, however, I am inclined, for reasons that will appear later in this paper (*cf.* the section on Serial Numbers) and from the results of informal tests made some years ago with the writing of numbers up to 100, to believe that the habit of guessing up and down the scale is by no means uncommon.

from these tendencies, but opened the way for others. One of these is guessing in round numbers. It is this which accounts for the prodigious excess in numbers ending in zero—guesses in even thousands, hundreds, and tens, all combining to swell the total.

Round Numbers. To estimate in round numbers is the natural way of dealing with anything that cannot easily be made definite. It is the way also that would appeal most strongly, in a "contest" of this sort, to indolent or careless guessers.

A similar tendency has been found to affect the tables of ages in the census returns and the lengths of judicial sentences, increasing notably the frequency of ages and sentences that end in zero or five. Williams, for example, gives tables for the range of ages from twenty-eight to forty-two for the states of Alabama, Michigan, and the whole United States, based on the census of 1880, of which the following table is a condensation.[1] The unit in the table is 1,000.

AGE.	ALA.	MICH.	U. S.	AGE.	ALA.	MICH.	U. S.
28	19.2	30.0	850.0	36	10.5	21.8	581.6
29	11.2	23.1	621.8	37	8.7	19.2	495.1
30	30.9	32.5	1,094.3	38	11.3	21.3	594.5
31	8.4	18.9	492.5	39	7.3	17.7	458.0
32	12.4	24.4	654.8	40	23.2	26.0	922.6
33	10.6	21.9	580.9	41	4.6	12.6	323.6
34	10.0	21.0	546.2	42	6.8	17.5	458.9
35	22.3	26.3	871.0				

The same sort of thing appears in some degree in the corresponding tables of the censuses of 1890 and 1900, in spite of definite efforts to lessen or exclude it.[2]

The following table of judicial sentences is given by Wines in his pamphlet upon prison statistics in the census of 1880.[3]

[1] Williams: Favorite Numbers, *Scientific American Supplement*, Vol XXVII, 1889, pp. 11,008-11,009.

[2] See the discussion of this matter in the Report of the *Twelfth Census of the United States*, 1900, Vol. II, pp. xxxv ff.

[3] Wines: American Prisons in the Tenth United States Census, New York and London, G. P. Putnam's Sons, 1888, pp. 24-26. Havelock Ellis gives similar data for English prisons in his work on "The Criminal," and Hewes gives a popular account of data gathered from the census of 1890 in *Harper's Weekly*, Vol. XL, 1896, March 14, p. 254.

Sentence.	No. of Cases.	Sentence.	No. of Cases.	Sentence.	No. of Cases.
1 year,	3,647	21 years,	120	45 years,	5
2 years,	6,028	22 "	10	46 "	1
3 "	5,026	23 "	10	47 "	1
4 "	2,355	24 "	23	48 "	1
5 "	5,112	25 "	102	50 "	18
6 "	1,021	26 "	2	54 "	1
7 "	1,291	27 "	6	55 "	3
8 "	653	28 "	5	60 "	5
9 "	206	29 "	2	61 "	1
10 "	2,316	30 "	73	75 "	3
11 "	77	31 "	1	99 "	82
12 "	337	32 "	1	Life,	1615
13 "	89	33 "	3		
14 "	153	34 "	4	Total,	31,925
15 "	657	35 "	9		
16 "	65	36 "	2		
17 "	62	38 "	1		
18 "	137	40 "	18		
19 "	26	42 "	1		
20 "	537	43 "	1		

The figures for the even fives and tens in these tables tell their own story. An age that must be determined by estimate, or the length of imprisonment that is best for a particular criminal is a matter that cannot be determined exactly. Approximations by five year periods are as close as many estimators find it convenient to go. In round number estimates of any sort, the number series is not used for its original purpose of enumeration, but merely as a convenient scale by which to indicate quantity, and, as a scale, it is properly used in fine or coarse divisions as the nature of the material dictates.

The notion of what constitutes a round number varies immensely with the nature of the thing to which the number is applied. We give the population of a city roughly as so many thousand; but the attendance at a concert as so many hundred, or at a social gathering perhaps as "eighteen or twenty." Thus, in Dresslar's data, where the guesses mostly fell below 1,000, all guesses in even hundreds are unmistakably round, and to these probably ought to be added those in even fifties, twenty-fives, and possibly also those in even tens. In the present study, where most of the guesses ran above 1,000, it was decided to define a round number guess as one in even thousands, hundreds, or fifties. Of these there were in the

1,043 cases now under consideration, 159, or something over one in seven. These are distributed as follows: In even thousands, 47; in even hundreds, 70 (of which 29 were in even five hundreds); in even fifties, 42.

The proportion of round number guesses falling in the different thousands is shown by the following table, the figures in which are percentages of the total number of guesses falling in each thousand. Guesses lying above 16,000 have been disregarded.

TABLE III.

Percentage of round number guesses falling in the different thousands up to sixteen thousand.[1]

Thousands.	Per cent. of Round Nos.	Thousands.	Per cent. of Round Nos.	Thousands.	Per cent. of Round Nos.
0 — 999	3	6,000 — 6,999	11	12,000 — 12,999	17
1,000 — 1,999	21	7,000 — 7,999	13	13,000 — 13,999	0
2,000 — 2,999	19	8,000 — 8,999	13	14,000 — 14,999	20
3,000 — 3,909	15	9,000 — 9,999	13	15,000 — 15,999	27
4,000 — 4,999	12	10,000 — 10,999	18	16,000 — 16,999	20
5,000 — 5,999	13	11,000 — 11,999	21		

It will be noticed that the proportion of round number guesses to the total number of guesses is higher at the ends of the range considered than it is in the middle. Those who guessed numbers between 1,000 and 3,000, or over 10,000, were more apt to guess in round numbers than those who guessed numbers between 4,000 and 10,000. In other words, those going widest from the actual number, *i. e.*, the more careless or less expert estimators, were in general more apt to deal in round numbers. The groups of instances on which the percentages for numbers above 11,000 are calculated are all small, but taking all instances from 11,000 to the upper limit of the group (1,000,000) nearly 22 per cent. of the guesses are in round numbers.

Particularized Numbers. Opposed to this natural tendency to estimate in round numbers is the tendency to particularization induced by the conditions of the "guessing contest." A prize is offered for the guess falling nearest to the actual number of beans in the bottle. The guesser knows that the actual

[1] See the foot note appended to Table I.

number must be a definite one, and therefore turns away from the round numbers, which for him are indefinite, toward some particularized number.[1] A round number also seems common and easy to think of, and therefore unlikely to be the right one. Furthermore, the round numbers form but a small part of the whole number series, and the chances are greater that the actual number will be some particularized one than that it will be a round one. A particularized number is therefore chosen, the guesser forgetting—the whole process of naïve guessing is unreflecting—that the chances are no greater that any single particularized number will hit the tale of beans in the bottle than that an adjacent round number will do so.

The operation of both tendencies—that to guess in round numbers and that to guess in particularized numbers—appears in the guessing of numbers lying just above or below round numbers, *e. g.*, such numbers as 7,001 or 10,099. Of these there are fifty instances in the group of guesses now under consideration, some appearing more than once. The distribution is as follows: Numbers ending in -01, 15; in -51, 14; in -49, 6; in -99, 15. The liability of the guessing of any given number (if we leave out of account the scattering guesses above 15,999) is about 1 in 16. The ratio of round numbers guessed to round numbers possible in the same range (285 to 15,999) is 1:3.7; and of numbers lying next to round numbers (with the exception of those ending in -49, which fall below the average for numbers in general) about 1:10 or 1:11. The full tendency to guess numbers lying adjacent to round numbers is not shown by these figures however. The number guessed lies often a little more remote from the round number, *e. g.*, 1,003 or 9,007, but where its character is evident. On the other hand, the tendency to guess numbers ending in -99 does

[1] By a "particularized number" I mean, of course, the opposite of a round number.

The particularizing tendency went so far with some guessers that a half bean was specified in half a dozen cases (*e. g.*, 4,035½), and in two cases a fraction of ¾ was set down. It is very likely that these guesses were made in sport, though possibly they may have been suggested by a stray half bean seen through the side of the bottle. But in any case they are evidence of the strength of the tendency to particularize. All fractions have been disregarded in the statistical study of the guesses.

not rest exclusively upon the fact of their falling just short of a round hundred, as will appear in the on section Repetitional Numbers. Indeed, in view of the small inclination to guess numbers ending in -49, it may be questioned whether the tendency is not almost exclusively toward guessing numbers lying just *above* round numbers.

Repetitional Numbers. Strong as the tendency is to guess round numbers some guessers appear to cut loose from it altogether and determine their choice according to striking features in the visual or the auditory form of the numbers, *e. g.*, the repetition of a single digit, as 3333 or 7777,—a tendency already noticed by Dresslar. Every number of this form between 999 and 11111, appears in our group of 1,043 guesses, and many of them more than once. The ratio of those present to those possible in the range from 285 to 16,000 is 1:1.5.

Many cases also occur where there is partial repetition, the last three or the first three digits of a four place number being alike, *e. g.*, 5222 or 5550. Of the first sort there are 17 different cases out of a possible 72 within the range of guesses now under consideration, a ratio of 1:4.2. Imperfect repetitional numbers with the unlike figure last (*e. g.* 5550) are much less frequent, occurring in only about one-tenth of the possible forms. If a guesser has set down the same digit in the thousands', hundreds' and tens' place, he is much more likely to go on and set it down also in the units' place than to turn off at that point to some other digit.

It is interesting to note that most of the repetitional numbers belong to the upper half of the digit series. This is due in part, doubtless, to the greater frequency with which all numbers belonging to these thousands appear, but it is not to be explained wholly in this way, for the same is true in a measure of the incomplete serial numbers (see the section on serial numbers). As the guesser, in constructing his four place number, ascends the digit series his range of choice becomes smaller and smaller (unless he is to turn back or to begin again) and he is thus pressed more and more to repetition. This would be especially the case when he has reached 9; and of the various repeated digits 9 is of most frequent occurrence, as may be seen in the table of preferred numbers below. With this also

co-operates the tendency to guess numbers adjacent to round numbers, which includes, of course, all numbers ending in 99. Guesses in which the digits are repeated in pairs (*e. g.*, 1212 or 5656) appear in about one tenth of their possible forms.

Symmetrical Numbers. A few instances occur when visual symmetry (or auditory rhythm) may have been a determining factor, as for example, 10101, which occurs twice in this form and once as 10101½.

Serial Numbers. Such tendencies as we have been considering are at least semi-conscious. Guessers yielding to them might, at least, be expected to know what they were about. This is also very likely the case when complete ascending or descending serial numbers are guessed, like 1234 or 9876, but with incomplete serial numbers, as 4789 or 6783 it may be questioned whether this is true.

Considering the range of numbers from the lowest guess in this group (285) up to 16,000, twelve types of complete ascending serial numbers are possible, leaving zero out of account. Five of these are found in the group before us (ratio 1:2.4), several being guessed more than once. Within the same range thirteen types of complete descending serial numbers are possible. Of these four are found (ratio 1:3.3), one of which (6543) was guessed four times.

The incomplete serial numbers have been investigated for the four place numbers only (1,000—9,999). Of these there are four types: 1. Numbers in which the serial part ascends and the non-serial digit comes *first* (*e. g.*, 7123). 2. Numbers in which the serial part ascends and the non-serial digit comes *last* (*e. g.*, 1237). 3. Numbers in which the serial part *descends* and the non-serial digit comes first (*e. g.*, 7321). 4. Numbers in which the serial part *descends* and the non-serial digit comes last (*e. g.*, 3217). Of each of these types there are 57 possible cases in the range considered (zero being disregarded as before). Of the first type 12 different cases are found among the guesses; of the second, 10; of the third, 7; of the fourth, 9 (ratios, 1:4.8, 1:5.7, 1:8.1, 1:6.3). One or two of the numbers of the second and fourth types are guessed more than once.

When it is considered that the general ratio of numbers guessed to all numbers within the limits of 1,000 and 9,999 is

about 1:11, it will be clear that there is a fair tendency to guess numbers of this serial sort. The guessing of incomplete serial numbers is, I believe, the result of the tendency already mentioned to advance in selecting a succession of digits, by short steps up or down the number scale. Even after the removal of all the special sorts of numbers so far considered there remains still some little indication of the serial tendency, though perhaps not more than would be accounted for by serial arrangements of two places (*e. g.*, -67, or -54) which have not been taken into account.

By way of a brief résumé of the influences that we have been considering we may turn to the following table, which includes all numbers guessed three times or more in the group of 1,043.

TABLE IV.

Numbers guessed three times or more.

ROUND NUMBERS.				REPETITIONAL NUMBERS.			
1,500	guessed	7	times.	9999	guessed	7	times.
2,000	"	5	"	8888	"	4	"
10,000	"	5	"	6666	"	3	"
3,000	"	4	"	7777	"	3	"
6,000	"	4	"	9997	"	3	"
7,500	"	4	"	SERIAL NUMBERS.			
8,500	"	4	"	6543	guessed	4	times.
9,000	"	4	"	OTHER NUMBERS.			
2,500	"	3	"	7840	guessed	3	times.
2,850	"	3	"	7989	"	3	"
5,500	"	3	"	10101	"	3	"
7,250	"	3	"				
7,850	"	3	"				
8,000	"	3	"				
11,000	"	3	"				
15,000	"	3	"				

Number Preferences. The round numbers, the repetitional and the serial numbers even with their imperfect types cover, however, about one-third only of the 1,043 guesses of this group. Seven hundred remain which do not fall into any of these classes. For the succession of digits in these we can say no more than "number preference," and can offer but such explanations as can be offered for that.

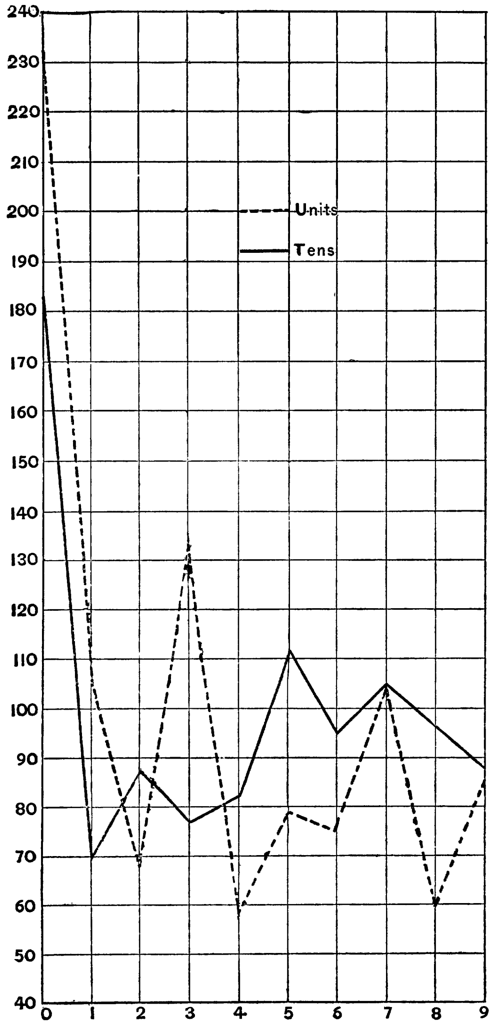
The preferences in the units' place have already been shown in Table II and the accompanying chart. Those in the tens'

place are shown in Table V and the chart below, where for convenience of comparison the frequencies in the units' place are shown again.

TABLE V.

Frequency per thousand of the various digits in the tens' place.

Digits.	0	1	2	3	4	5	6	7	8	9
No. per M.	185	69	88	77	82	112	95	105	97	88



The most striking difference is the partial smoothing of the curve due to the almost complete disappearance of the advantage of the odd numbers over the even. This means, of course, a general lessening of preference. For digits in the hundreds' place the uniformity is still greater. It is evidently the final figure that is most significant in this respect in the mind of the guesser.[1]

The order of preference for the digits in the units' place is: 0, 3, 1, 7, 9, 5, 6, 2, 8, 4; in the tens' place: 0, 5, 7, 8, 6, (2, 9), 4, 3, 1.[2]

The most marked change is the ascent of 5, 8 and 6, and the descent of 3, 1 and 9. Five is favored in the tens' place by the habit of guessing in round 50's; 1 and 9 in the units' place owe their importance, in part at least, to their serving in numbers adjacent to round numbers; and this fails them in the tens' place. For the advance of 6 and 8 in the tens' place and the descent of 3, no reason can now be offered. A digit in the tens' place is, of course, not simply the digit moved one station to the left. It means a different thing and has a different name. The verbal number system is not so simple as the visual system (Arabic figures); 50, for example, is "fifty" not simply "five tens." All of the numbers up to 100 have thus an individuality of their own, and even larger numbers may, perhaps, have something of it.

It was thought that perhaps a preference might show itself for certain combinations of tens and units in the numbers under 100, and a table was prepared giving the frequency for the various combinations. The total number of guesses in the group (1,043), is not sufficient to give precise results when distributed over so long a list of possibilities, but a few points stand out with some clearness. The most general relation discovered was a tendency of high digits in the tens' place to have high digits following them in the units' place, and low digits to have low—a relation which still holds in a slight degree when such serial and repetitional numbers as might contribute

[1] Dresslar's tables show the same relation between the frequencies of the digits in the tens' and units' places, though the advantage of the odd numbers persists to a greater extent than in the figures of Table V.

[2] Numbers in parentheses have equal frequencies.

to that result are thrown out. The same is true of the succession of digits in the hundreds' and tens' places. This difference is probably no more, however, than would be accounted for by repetitional and serial tendencies confined to two successive digits.

There is a considerable range in the frequency with which the different combinations appear. Leaving out of account the round, repetitional and serial numbers, the following appear as combinations of high frequency, reading from highest to lowest in the first case, and from lowest to highest in the second.

High frequency:[1] 75, (20, 60, 63), 76 (43, 87).

Low frequency: 66, (48, 88, 94), (14, 46, 95).

The number 75 undoubtedly owes its prominence, in part at least, to its marking three fourths of 100; but 25, on the other hand, is not helped in any great degree by marking one fourth.

It was also thought that numbers made prominent as products in the multiplication table might stand high, but no such relation appears. It was thought again that there might be some tendency to serial or repetitional numbers of two places, like 5152 or 4545, since in reading numbers of four places it is not uncommon to make two groups of two digits each rather than a group of one and one of three. Numbers of this type were found, but not often enough to indicate a preference for them. Neither was there any other relation of a general character discovered.

An explanation of number preferences, if one is attempted, must take several things into account. First and most important of these is that number preferences—so far at least as they can be judged by mass returns—are not constant, but vary with the conditions under which the numbers are used. The odd numbers are preferred in the units' place in "guessing contests," but the even (next after the 5's and 10's) in the estimation of ages, and two years is the most frequent criminal sentence. Under some conditions the landmarks of the decimal system (5, 10, 15, 20, etc.) would be prominent; under others those of the duodecimal system; under still others, numbers not belonging to the series of whole numbers at all, as in parts of the country where the "bit" and "shilling" are still

[1] Numbers in parentheses have equal frequencies.

used as money of account. Number preferences should be explained, therefore, in connection with the special circumstances under which they are exhibited.

In explanation of the preference for odd numbers in the units' place in the squash guessing contest, and especially for the prominence of 7 and 3, Dresslar suggests that they may be connected with number superstitions and symbolisms. He remarks, on p. 784 of the paper already mentioned, "it would certainly be unjustifiable to conclude from the evidence at hand that the preferences shown in the guesses under consideration are directly traceable to some such superstition; and yet one can scarcely prevent himself from linking them together." A connection between the two there very probably is, but it lies, I believe, in the fact that both number superstitions and number preferences in free guessing spring from a similar psychical condition. There must be something peculiar about a number to which superstition or symbolic meaning may cling; it must somehow stand out in consciousness. The emphasizing feature may be something in the numerical relations themselves (as 30 is the sum of the first ten numbers of the series, to use one of Dresslar's instances), or it may be some relation in nature, as man's having five fingers on each hand, or the quarter of the lunar month being seven days, or perhaps some purely accidental relation—but whatever its nature, it must make the number prominent in consciousness before it can become a matter of superstitious regard. Now in such guessing as we have been considering, mere prominence in consciousness, or mere ease of return to consciousness, for any cause, is sufficient to determine a preponderant frequency in the guessing. Superstitious importance when once established may easily contribute to the prominence of a number, and so increase its frequency in the records of the guessing, but its influence is indirect and much modified by other considerations. The number 13, for example, would generally be regarded as an unlucky number—though, to be sure, the specific superstition is about sitting thirteen at table—yet in the group of guesses under examination numbers ending in -13 are not avoided at all. On the contrary this termination belongs to the favored group, being guessed more than any other number lying in the

'teens and one-third more than the average. Its unlucky reputation, if it is effective at all, seems in this case to have favored its frequency by making it prominent in consciousness. In such guessing as that now under consideration, the guesser picks out numbers of a certain distinction and passes by those that seem ordinary. All the odd numbers stand out above the even for purely numerical reasons. They present a certain solidity because they are not divisible by two, and among the odd numbers 3 and 7 over-top the rest; for 9 is not prime, 5 is common and easy from its connection with the decimal system, and 1 from its simplicity and complete familiarity. To such original means of emphasis as this is added the repetition and fixation in attention due to superstitious or symbolic conceptions, and all combine to determine the otherwise undetermined digits in the number guessed.

Guesses of the Women and Girls. With regard to the guesses of the women and girls all that need be said is that they did not differ more from those of the men and boys than would an equally numerous group selected at random from the men's and boys' list. On the contrary it is rather remarkable that so small a group should show such slight variations from a large one.

The group consisted of 244 guesses made by 114 persons, an average of a little over two guesses to each person. It differed from the group just considered in containing the guesses of a few persons who guessed more than five times, but the number thus added was hardly worth considering. The guesses range from 250 to 2,675,181,756, the one before the highest being 69,625. The median guess is 7,571+, the median of the upper half series is 8,929+; of the lower 5,827+. The range from 1,200 to 16,000 includes a little more than nine-tenths of the guesses. The percentage of round number guesses in the full 244 guesses is 15.2 per cent. (men's list 15.2 per cent.); of numbers adjacent to round numbers 6.1 per cent. (men's list 5.9 per cent.); of repetitional numbers between 333 and 9,999 4.6 per cent. (men's list 6.4 per cent.); of serial numbers (between 1,000 and 9,999) 5.8 per cent. (men's list 7.7 per cent.).

The following is the list of numbers guessed more than once:

Round Numbers.	Repetitional Numbers.
1,000	7777
5,850	8999
6,500	9999
7,000	
7,450	
8,000	**Serial Numbers.**
	6321
Miscellaneous.	6783
9,642	7654

The only number guessed more than twice was 8,000 which was guessed four times.

It is possible, of course, that in a very large mass of data some variation between the guessing habits of men and women might appear, but it is not at all likely. It would be hard to find anything in the mental world more desiccated than the number system, and therefore more unlikely to give ground for differences in emotional attitude, or to discover any form of activity in which the sexes would stand upon so nearly an equal footing of experience as in the guessing of the number of beans in a bottle.

Summary. The data presented seem to me to bring out clearly several points with regard to habits in the guessing of numbers. (1) These habits are not fixed and constant, as seems generally to have been assumed, but vary characteristically with variations in the conditions under which the guessing is carried out. (2) Two-thirds of the guessers in the "guessing contest" here studied made use of particularized numbers, showing more or less preference for certain digits, especially in the unit's place. (3) About one-third guessed round numbers or those adjacent to them, or numbers showing a repetitional or serial character in the digits chosen. There was also a slight, but uncertain, indication of a more general tendency to move, in choosing a series of digits, by short steps along the digit scale. (4) No evidence was discovered that the guessing habits of women and girls differed from those of men and boys.